

[001] SHIFT DEVICE FOR A TRANSMISSION

[002] This application is a national stage completion of PCT/EP2004/006120 filed June 7, 2004 which claims priority from German Application Serial No. 103 30 158.5 filed July 4, 2003.

[003] FIELD OF THE INVENTION

[004] The present invention concerns a shift device for a transmission with a cam drive, which has a shifting roll guidedly rotatable about an axle, as well as selector fingers which engage in grooves on said shifting roll and are regulated therein.

[005] BACKGROUND OF THE INVENTION

[006] Known to the practice are shift devices for speed-changing transmissions for motor vehicles, which have a cam drive for creating movements of the shifting forks, which are connected to selector fingers. The control contouring of the cam drive is in the form of grooves on the circumference of the shifting roll whereby a control curve has been designed for each shifting form. The selector finger, which is linked to the shifting fork, engages itself in such a manner, that upon rotation of the shifting roll, a continuing shifting motion in an axial direction of the shifting roll is made available on the selector fingers which motion runs from downshift to an upshift gear stage or conversely from an upshift stage into a downshift stage. During the shifting operation, the shifting forks, respectively, run through an idling position between two gear stages.

[007] In the case of multiple-downshifts, these shift devices have the disadvantage that a fixed sequence of shifting operations must be observed. This means that, in the case of a multiple-downshifting, continually one gear stage after another must be engaged and then disengaged, until the desired gear stage is activated in the transmission. The sequential succession of shifts leads to a considerable prolongation of the total time of shifting.

[008] In the case of multiple-downshifting, in order to overcome this disadvantage, the practice has moved in a direction, wherein the desired gear stage is selected in a direct manner that means without a sequential run of shifts in the transmission. For this purpose, the shifting forks, in the case of multiple-downshifting, which are in a position corresponding to the actual shifted-into gear stage, are taken out of the present engagement with the shifting roll and guided into their neutral position with the aid of equipment adapted to that purpose.

- [009] Subsequently, the shifting roll has rotated so far in the direction of the downshifting that the position, corresponding to the shifting forks for the desired gear stage has been attained and the shifting forks can be run out of their neutral position. By way of this method of operation, in the case of multiple-downshifting, the sequential shifting through each gear stage is redundant, whereby in this multiple-downshifting through several gear stages, that is "gear jumps", considerably shorter shifting times are achieved.
- [010] DE 195 09 477 teaches of a shift device wherein, during multiple-downshifting, the shifting equipment, which finds itself in its idling position, is brought out of engagement with the controlling cam, whereby a movement of the shifting equipment into a shifting direction out of the idling position is blocked and the shifting roll, without releasing interposed shifting in the transmission, turns into the desired positions.
- [011] After this, the shifting equipment is once again brought into its engagement with the cam control of the of the shifting roll.
- [012] At the base of the controlling cams are provided traversable ramps in the direction of shifting roll rotation for downshifting. These are situated in front of the shifting path curvature of the cam control so that the selector fingers are blocked from the shifting direction by a restraining apparatus during multiple-downshifting as they approach these ramps.
- [013] The above situation still has the disadvantage that, during a traversing of the ramps to achieve the blocking by the restraining apparatus, which is provided with the shifting forks and which forks, in turn, are bound to the selector fingers, the system is burdened by complex construction, whereby high fabrication costs are caused and additional controls must be provided.
- [014] In order to avoid this disadvantage, DE 102 03 633 A1 proposes a shift device for a transmission with a cam drive, which has a shifting roll with at least one groove, wherewith, at least one selector finger engages itself therein so that, upon a rotation of the shifting roll, the selector finger moves axially and whereby the groove possesses for shifting up, an upgear groove designed as an upward shifting path and, conversely, for downshifting, has a downshift path. In this design, the downshift path is constructed as a downshift groove, which conducts the selector finger, during downshifting or during multiple-downshifting, into a axial shift position equivalent to a neutral position.
- [015] The downshift groove is provided with an effective blocking means, which is active during a shifting roll direction of rotation equivalent to an upshift so that

the selector finger, during an upshift is guided by the upshifting groove and during a downshift is guided by a downshift groove.

[016] By way of this design of the downshift path as a downshift groove, which places the selector finger into a shifting position equivalent to a neutral position during a multiple-downshift occurrence, it is possible that multiple-downshift operations can be carried out without a running through of sequential gear stages, whereby shorter shifting times can be achieved.

[017] The provision of a blockage apparatus in the downshift groove, which is effective in a direction of rotation of the shifting roll equivalent to a upgear shift direction thereof, leads to a situation where the selector finger is guided through an upshift groove during an upshift and during a multiple-downshifting is guided through a downshift groove to the end that the selector finger upon upshift or, during multiple-upshifting, is guided by the sequential upshift path and during multiple-downshifting is guided in a direct path into its neutral position. Thereby, the desired reduction of the shifting time is achieved by multiple-downshifting.

[018] In the case of the above described known shift device, however, a multi-path of the shifting roll is yet to be considered and also a reversal of the direction of rotation of the shifting roll between the upshifting and the downshifting is necessary.

[019] The purpose of the present invention is to create a device, with which the gear stages both, in the case of upshifting as well as downshifting, are freely selectable without a sequential run through gear stage positions, and without the necessity that a multi-path course of the shifting roll must be run through or a reversal of the direction of rotation thereof becomes necessary.

[020]

[021] SUMMARY OF THE INVENTION

[022] The proposal is made that a shift device be designed as a passive, speed of rotation controlled system, wherein finding the goal to be attained, for either upshifting or downshifting, would be considered as a function of the speed of rotation of the shifting roll, which attainment would be enabled by centrifugal force engendered by the speed of rotation.

[023] According to the invention, provision has been made within the framework of an advantageous embodiment of the present invention that rocker elements are placed on the outer circumference of the shifting roll, which rocker elements have wedge-shaped tips. These tips are so placed about a rotational axle that they can

engage themselves into an appropriate groove, whereby the rotational axle is perpendicular to the appropriate groove and whereby a compression spring is located to one side of the rotational axle of the rocker element. In this way, the wedge-shaped tips of the rocker elements determine the path of the selection fingers for both upshifting and downshifting. The compression spring, which exerts its force upon the rocker element, serves to make certain that if a shifting roll is rotating slowly, the wedge-shaped tips of the rocker elements so engage in a groove. If the shifting fork finds itself in the neutral position with the shifting finger and the shifting roll turns back, the shifting finger, as in a case with conventional shift devices, transfers out of the neutral groove and into the (inclined) gear groove so that a desired gear position is obtained.

[024] Conversely, if the shifting roll is rotating more rapidly, then because of a rotational axle (axis) for the rocker element, which axis is located perpendicular to the respective groove, an action is carried out so that, because of increased centrifugal force, a torque is brought about on the rocker element which opposes the spring force. By this activity, the rocker elements pivot about their rotational axis so that the wedge-shaped tips are forced out of engagement with the fingers. The respective selector finger, as a result, is no longer diverted into the direction of the gear groove, but is allowed to remain in the neutral position.

[025] When upshifting occurs, then the operational principle reverses itself, because of the asymmetrical arrangement of the rocker elements. That is to say that in a case of slower rotation of the shifting roll, the selector finger remains in the neutral position and upon a more rapid rotation thereof, is directed into the gear groove.

[026] The invented design of the shift device offers more advantages. First, an additional actuator can be eliminated, since now a "passive" employment of the centrifugal force on these grounds, has the effect that gear stages, both in upshifting and downshifting, become freely selectable so that a running through of gear sequences can be done away with. Second, there is no necessity that the shifting roll must travel through a multi-gear path nor carry out a reverse of direction, because no greater paths exist to force such action.

[027] In a case of simple shifting, because of an identical shifting procedure, the same shifting time is necessary as in the case of the conventional shift devices which have a shifting roll. In the case of multiple shifts, the desired gear position is found directly without multiple paths and without a rotational direction reversal of the shifting roll. In this way, a clear diminution of the shifting times

has been achieved, because of the elimination of the no longer needed mutual synchronization.

[028] BRIEF DESCRIPTION OF THE DRAWINGS

[029] The invention will now be described, by way of example, with reference to the accompanying drawings in which:

[030] Figure 1 is a development of a shifting roll; and
 Figure 2 shows the finger engaging with a groove of the shifting roll.

[031] DETAILED DESCRIPTION OF THE INVENTION

[032] Since shift devices with shifting rolls are well known to those skilled in the art, in Figure 1 only those components which are necessary for understanding the invention are presented in a purely schematic manner. As shown in Figure 2, the the shifting roll 7 is rotatably about an axle A and the shifting roll has grooves G thereon as well as a respective selection finger F which can engage within each respective groove.

[033] The rocker elements, which find their place on the outer circumference of the shifting roll, are designated with the reference number 8, whereby these each turn about a respective rotational axis 6, which is arranged so as to be perpendicular to the corresponding groove. Each groove of the shifting roll possesses an encircling neutral groove, which has a connection with the appropriate gear stage. The rocker elements 8 are provided, on one end with wedge-shaped tips 1, 2, 3, 4, 5 and, on the other end with wedge-shaped tips 10, 11, 12, 13, 14 and are located so that the wedge-shaped tips 1, 2, 3, 4, 5 determine the path of the selector fingers F during upshift and downshift. For this purpose, a compression spring 9 is arranged on one side of the rotational axis 6 of each rocker element 8 which loads the rocker element in that way so that one of the associated wedge-shaped tips is located within the groove.

[034] The force of the spring 9 is regulated so that, during a slow rotation of the shifting roll, the engagement of the wedge-shaped tip remains in place so that, if the shifting fork finds itself with the corresponding selector finger in the neutral position and the shifting roll rotates backwards, the selector finger F is diverted out of the neutral groove and transferred to the gear stage groove in the same manner as is carried out in the case of the conventional shift devices which have shifting rolls.

[035] Otherwise, in the event of a quick rotational reversal of the shifting roll, because of the asymmetrical design of the rocker elements 8 on their rotational axes 6, the rocker elements are subjected to a torque, due to the occurring centrifugal force, which works against the biasing force of the spring 9 so that the rocker elements pivot and the pivoted wedge-shaped tip cannot engage itself in the respective groove. By this means, the selector finger F is no longer diverted, but remains in the neutral position as a result of this quick rotational reversal of the shifting roll.

[036] The operating principle reverses itself in the case of upshifts so that, in such cases, upon a slow rotation of the shifting roll, the selector finger F remains in the neutral position and, contrarily, upon a rapid turning of the shifting roll, is diverted in the direction of the shifting groove.

[037] In the following, the functioning of the invented shift device is explained in details.

[038] Simple Downshift

[039] The shifting roll is slowly reversed, under which circumstances, the force of the compression spring 9 is greater than the torque created by centrifugal force. As a result, the wedge-shaped tips 1, 2, 3, 4, 5 of the rocker elements 8 remain in neutral engagement and are capable of being shifted in a sequential manner. This is inevitable if the force of the spring is not overpowered by centrifugal force.

[040] Multiple (double) downshifting

[041] The shifting roll is, first, placed in rapid, reverse speed of rotation. As this occurs, the wedge-shaped tips 1, 2, 3, 4, 5 of the rocker elements 8 are not in engagement with a respective groove so that the selector fingers F remain in the neutral position. Following the occurrence of the corresponding rocker element 8 (before approaching the desired gear stage to be engaged), the speed of rotation of the shifting roll is reduced to such an extent that all rocker elements are again in a groove engagement. The selector finger F is now diverted in the gear groove and the corresponding gear position is attained.

[042] Simple upshifting

[043] The shifting roll is turned at a high rotational speed, so that the rocker elements 8 are in groove engagement by their wedge-shaped tips 10, 11, 12, 13, 14 and shifting in a sequential manner is possible.

[044] Multiple (double) upshifting

[045] The shifting roll is turned at a slow speed in the direction of upshifting so that the deflecting wedge-shaped tips 10, 11, 12, 13, 14 are not in groove engagement and the selector fingers F remain in the neutral position. Before the desired gear stage is shifted into, the shifting roll is rotated rapidly so that now the wedge-shaped tips 10, 11, 12, 13, 14 are in groove-engagement, a selector finger F is diverted into a gear groove, and the desired gear stage is shifted into.

[046] The invented embodiment of the shift device also enables a passively, regulated choice for upshifting as well as for down shifting, these serving as a function of the speed of rotation of the shifting roll and with the usage of the centrifugal force which arises thereby. Although an especially advantageous embodiment has been described, the fundamental concept of the invention can be applied to additional appropriate operations.

Reference numerals

- 1 tip
- 2 tip
- 3 tip
- 4 tip
- 5 tip
- 6 rotational axis for the rocker element
- 7 shifting roll
- 8 rocker element carrying tips and spring
- 9 compression spring
- 10 tip
- 11 tip
- 12 tip
- 13 tip
- 14 tip
- N neutral position
- R reverse gear
- 1' first gear
- 2' second gear
- 3' third gear
- 4' fourth gear
- 5' fifth gear
- A roll axle
- F selector finger
- G groove